

**PACKAGE ID** - 000253CY01S00 NACHOS2\*

**KWIC TITLE** - Incompressible Viscous Fluid Dynamics

**AUTHORS** - Gartling, D.K  
Sandia National Labs., Albuquerque, NM (United States)

**LIMITATION CODE** -UNL                   **AUDIENCE CODE** - UNL

**COMPLETION DATE** - 02/01/1989   **PUBLICATION DATE** - 02/21/1992

**DESCRIPTION** - NACHOS2 is a finite element program designed for the analysis of two-dimensional, incompressible viscous fluid flow problems. The basic flows considered may be isothermal, nonisothermal, or may involve other physical processes, such as mass transport. Both steady and transient flows may be analyzed. The class of problems treated are those described by the two-dimensional (plane or axisymmetric) incompressible form of the Navier-Stokes equations. An energy transport equation is included in the formulation for problems in which heat transfer effects are important. Two auxiliary transport equations can be added to describe other physical processes, e.g. mass transfer, chemical reactions. Among the specific types of flow problems treated are: isothermal flow; forced, free, or mixed convection; conjugate heat transfer; flow in saturated porous media with or without heat transfer; and inelastic, non-Newtonian flows with or without heat transfer. Other problem classes are possible depending on the specific definitions applied to the auxiliary transport equations.

**PACKAGE CONTENTS** - Media Directory; Software Abstract; SAND-86-1816 Pt. 1; SAND-86-1817 Pt. 2;

**SOURCE CODE INCLUDED?** - Yes

**MEDIA QUANTITY** - 1 CD Rom

**METHOD OF SOLUTION** - NACHOS2 is based on the Galerkin form of the finite element method. It utilizes an element library consisting of six-node triangular elements, and eight-node, and nine-node quadrilateral elements. The fluid velocity and temperature are approximated using quadratic interpolation. The pressure is represented using either linear or bilinear functions. The frontal solution method is used for direct solution of the matrix problem. All equations in a problem are solved in a fully coupled manner. For steady-state simulations the standard Picard method is augmented with a full Newton method and a quasi-Newton procedure. Transient analyses are performed using either a backward Euler or a trapezoidal rule integration procedure. Either method can be run with a fixed timestep or a dynamic timestep selection procedure.

**COMPUTER** - CRAY1S

**OPERATING SYSTEMS** - CTSS;COS (Cray)

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**PROGRAMMING LANGUAGES** - FORTRAN 77

**SOFTWARE LIMITATIONS** - NACHOS2 is restricted to problems for which the fluid of interest may be assumed incompressible within the context of the Boussinesq approximation. Isotropic behavior is assumed for all fluids, solids, and porous materials; all fluids are assumed to obey a Newtonian or generalized Newtonian (inelastic) constitutive law. No provision is made for the explicit computation of fluid/fluid interfaces (i.e. free surfaces).

**SOURCE CODE AVAILABLE (Y/N)** - Y

**UNIQUE FEATURES** - The program is self-contained with its own mesh generator and plotting facilities. It can also be used with stand-alone mesh generators. The batch plotting package in NACHOS2 permits a full range of plots at the option of the user. Plots of the finite element mesh can be generated, as well as contours, time histories, profiles and vector representations of all the relevant dependent variables in an analysis.

**RELATED SOFTWARE** - NACHOS2 uses utilities from the SUPES package; these routines are included.

**OTHER PROG/OPER SYS INFO** - NACHOS2 requires the proprietary CA-DISSPLA Version 10.0 graphics software. This software is not provided.

**TIME REQUIREMENTS** - Execution time is problem and mesh dependent.

**REFERENCES** - D. K. Gartling, NACHOS II - A Finite Element Computer Program for Incompressible Flow Problems, PART I-Theoretical Background, SAND86-1816, April 1987, with January 19, 1989 update; D. K. Gartling, NACHOS II - A Finite Element Computer Program for Incompressible Flow Problems, Part II-User's Manual, SAND86-1817, September 1987, with January 19, 1989 update; NACHOS2, NESC No. 9489.VAX8, NACHOS2 DEC VAX Version Tape Description, National Energy Software Center Note 89-70, July 3, 1989; NACHOS2, NESC No. 9489.CRAX, NACHOS2 Cray Version Tape Description, National Energy Software Center Note 89-69, July 3, 1989.

**ABSTRACT STATUS** - Abstract first distributed July 1989. Cray version submitted February 1989. DEC VAX version submitted February 1989.

**SUBJECT CLASS CODE** - H

**KEYWORDS** -

COMPUTER PROGRAM DOCUMENTATION  
N CODES  
VISCOUS FLOW  
TWO-DIMENSIONAL CALCULATIONS  
MASS TRANSFER  
HEAT TRANSFER

E S T S C  
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SOFTWARE ABSTRACT

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CHEMICAL REACTIONS  
FINITE ELEMENT METHOD  
INCOMPRESSIBLE FLOW  
NAVIER-STOKES EQUATIONS  
CONVECTION

**EDB SUBJECT CATEGORIES** -  
990200 420400 665000

**SPONSOR** - DOE/DP

**PACKAGE TYPE** - SCREENED